ELECTRON-ION COLLIDER DETECTOR ADVISORY COMMITTEE

Report of the 14th Meeting held at BNL, 18 – 19 January, 2018

BNL, in association with Jefferson Laboratory and the DOE Office of Nuclear Physics, has established a generic detector R&D program to address the scientific requirements for measurements at a future Electron Ion Collider (EIC). The primary goals of this program are to develop detector concepts and technologies that are suited to experiments in an EIC environment, and to help ensure that the techniques and resources for implementing these technologies are well established within the EIC user community.

The EIC Detector Advisory Committee meets twice a year, typically in January and in June. The current Committee members are: M. Demarteau (ANL/Chair), C. Haber (LBNL), P. Krizan (Ljubljana University/J. Stefan Institute), I. Shipsey (Oxford University), R. Van Berg (U. Pennsylvania), J. Va'vra (SLAC) and G. Young (JLab). Regretfully, Marcel Demarteau, Peter Krizan and Ian Shipsey were unable to join the meeting. During the January meeting progress reports are reviewed and feedback is provided to the proponents. During the June meeting both progress reports and new proposals are reviewed. Funding recommendations for continuation of existing and for new proposals are provided by the Advisory Committee to the program manager in advance of the fiscal year funding cycle.

The EIC Detector Advisory Committee met at Brookhaven on January 18 and 19, 2018 to hear status reports of the eleven funded projects and also a presentation by the BNL Instrumentation Division. Progress reports were submitted before the meeting and evaluated by the committee. The committee would like to thank all the collaborations for their excellent presentations and status reports and are to be commended for their progress. The committee was pleased to see the results of the R&D under this program be published in peer-reviewed journals.

The committee would like to mention again the modified process for proposals under this research program to make the meeting and overall process more efficient. New proposals will have to be submitted 8 weeks before the EIC advisory meeting and will be pre-screened. Feedback will be provided 30 days before the meeting and the proponents will be notified if they are invited to present their proposal at the meeting. There will be no change to the procedure for on-going projects. The remainder of the report provides the feedback on all ongoing research projects.

eRD1 EIC Calorimeter Development

T. Horn and O. Tsai, reporting

Tungsten-fiber calorimeter development

The Committee takes note that the fiber-tungsten EM Calorimeter development has now led to working prototypes with good energy and position resolutions, a choice of readout technology, all coupled with levels of radiation hardness that would result in a capable EM calorimeter for the barrel and hadron-going directions at an EIC. The collaboration is to be congratulated on this achievement. One could remark that the concepts developed to date are ready to be incorporated into the design for an EIC detector, and indeed a version will be built in the next years for sPHENIX. That said, there is still room for improving performance, as reported by the eRD1 group.

The sPHENIX group reported fabrication of a new prototype, denoted v2.1, that addresses the issues noted earlier with light collection from the tower/block edges and the design of the light guides. This large-scale prototype will be tested soon in the FNAL test beam and is expected to serve as a final pre-production prototype. It therefore includes designs for the cooling system, light guide coupling, electronics readout, and choice of SiPM and electronics. Results of a simulation study, made by ray-tracing, of light collection by the light guides were presented and shown to identify a significant source of non-uniformity in EMCal position response. The radial space constraints in a collider, in particular with the BaBar magnet that is being re-purposed to sPHENIX, dictate that longer light guides are not feasible. sPHENIX can accept this loss of resolution but a new EIC detector should not. Possible options going forward include tiling a larger area with SiPMs, which may well be feasible given the new development of 6mm x 6mm SiPMs and the ongoing decrease in SiPM price. The Committee repeats the remark from the last report of the need to improve the light collection uniformity via work on fiber placement and routing as well as the work on coupling of readout devices such as SiPMs to the fiber-tungsten matrix, and to continue study of light-guide geometry and the trade-off between radial compactness, which favors short guides, and uniformity of response, which favors long ones. Light emission from the fibers favors addition of a diffuser between fiber and SiPM to utilize the full matrix of micro-pixels of a SiPM; space for this would need to be found also.

The collaboration has also continued their measurement of the effects of radiation exposure to the long-term performance of SiPMs. A set of measurements in the STAR interaction region, near the DX dipole, was presented. However, the results in the written report submitted this time were hard to follow or interpret. It was not clear how to understand results as a function of SiPM overbias voltage and how temperature control was accomplished, although the Committee notes that earlier reports did address temperature control and HV bias compensation. The group deprecates the use of APDs for W-SciFi readout as a consequence of these studies. The group also notes the need to pre-select and pre-sort the SiPMs.

As a consequence this study points to the need for a good monitoring system for a W-SciFi calorimeter, more so given the SiPM aging behavior. The design of this could be a subject of future development.

Actions/Recommendations:

1. The Committee would like to see prior resolution studies presented as a group, with fits, and to include plots of resolution vs 1/sqrt (E) to make the constant term quickly evident. The Committee also wants to see behavior of energy resolution and total shower energy as a function of transverse position across the face of a series of towers.
2. The Committee would like to see the results from the upcoming test beam studies of the sPHENIX v2.1 prototype with an emphasis on transverse and angular position dependence. This program has then reached a good point to wrap up its efforts for this phase of the R&D.
3. Clarify the description of the effects of radiation exposure to the SiPMs

Shashlik Concept

The Committee would like to see a study of the parameter space for a shashlik EMCal as a first element in a discussion about pursuing their development. Several such devices are in operation, thus there is a database of established performance. Many of these use lead absorbers; it is of interest to explore denser absorbers as a path to a shorter radiation length and smaller Moliere radius as a step in developing a device compact enough to be useful inside the spectrometer magnet bore at a collider. Because the light generated is mixed via the use of WLS fibers to transfer it from the scintillator tiles to the photon sensor, one expects a transversely uniform response, as noted in existing devices. Whether the segmentation of the readout needs to be at the individual fiber level, as suggested in the prior meeting of this Committee, is not clear and would need also some parametric study. There does appear to be the advantage of having a pre-shower section via a longitudinal segmentation of the WLS fibers and installation of an inner photon sensing layer; whether this is cost-prohibitive needs to be studied. Given the high degree of transverse segmentation proposed, of order one Moliere radius, the group is commended to read the studies by L3 comparing longitudinal and transverse segmentation of their BGO EMCal.

Actions/Recommendations

1. Study the parameter space for a shashlik EMCal in order to clarify issues such as longitudinal and transverse segmentation as noted above.

Crystal calorimeter development

The Committee takes note of the ongoing effort to characterize lead-tungstate crystals from Crytur and SICCAS and recognizes the need to qualify a vendor in order to be able to propose a high-resolution scintillating crystal EMCal for the EIC. The group has established required values for light yield, uniformity and radiation resistance for such a crystal-based EMCal at the EIC and is actively pursuing measurements to determine if presently-produced crystals meet them. The measured results are now at a level to provide useful feedback to potential vendors. The effort for the EIC benefits from the work being done for the Neutral Photon Spectrometer at JLab by several of the same people.

New results on chemical composition were reported, together with microscopic examination of sample crystal surfaces. The contaminants observed lead to some concern about chemical purity of starting chemicals, cleanliness of the crucible used, and control of the crystal pulling (in

particular the formation of bubbles.) The sources of the surface defects have to be tracked down; one can hope that its resolution will turn out to be simple improvements in the polishing step.

The Committee repeats the following from its last report. “The importance of achieving a small constant term in the normalized resolution was stressed by the collaboration and studied in simulation results reported. It would be of interest to see further analysis of contributions expected to this limiting behavior, including uniformity of response, calibration precision among different towers, rear leakage of showers, dependence on angle of incidence, and the amount of allowable dead zone between towers. For future reference it would be useful to have an understanding of the proposed size of a tower, notably the number of radiation lengths, as well as shape of a tower. The collaboration mentioned a trapezoidal longitudinal shape to improve uniformity of response; the related efforts on the L3 BGO calorimeter for LEP and their coating with TiO2 to flatten the response as a function of depth could be of interest here.”

The Committee was quite interested to learn of the nascent work on readout sensors, including the plan to couple newly-available 6mm x 6mm SiPMs to crystals and measure their behavior. Preserving all the photon statistics, procured of course at significant price in a crystal EMCal, is of great interest. Pursuit of this development is encouraged.

If an adequate number of crystals can be obtained, it would be of interest to see a plan for a test beam program that includes establishing the limiting energy and position resolution and a determination of the uniformity of response, both energy resolution and energy sum, as a function of transverse position and angle of incidence

The Committee looks forward to the future reports of the collaboration and their plan to address the issues noted above.

Actions/Recommendations

1. As requested already, the Committee looks forward to seeing an analysis of the constant term.
2. As noted, pursue a test beam program to establish limiting resolution, and uniformity as a function of transverse position and angle of incidence.

eRD3 – Design and assembly of fast and lightweight forward tracking prototype systems for an EIC

M. Posik reporting

The new large optical scanner seems to perform well and has been used for scanning multiple different GEM foils produced by both CERN and Tech-Etch. Many scans were also performed as part of the collaboration with eRD6 efforts.

Reported difficulties in imaging thin chromium layers might be addressed by illumination by a restricted wavelength range or direction.

The larger leakage current observed in chambers built using Kapton ring spacers instead of the more traditional G-10 spacers is interesting and the project plans on following up on this puzzle.

The committee is pleased to see the increasing interaction with the eRD6 efforts and expects that a single joint eRD3/6 proposal will be submitted for any proposed FY19 work.

Actions/Recommendations

1. Report on leakage current study and conclusions
2. Submit proposals for FY19 jointly with eRD6

eRD6 – The EIC Tracking and PID Consortium

K. Gnanvo reporting

The improvements in performance of the zigzag readout boards already attained and expected to be obtained shortly is very encouraging. It would be good to hear a summary at the next meeting of what further advances might be expected and what the gain would be in physics reach. The planned beam tests, cosmic ray tests and X-ray scans should prove very interesting.

The innovative low radiation length and low-cost methods of assembling large GEM detectors at both Florida and Virginia is impressive. The committee looks forward to the results of the beam tests this summer.

The new high rate tests of chromium only GEM foils seem promising and the fallback of having Cu on just the last surface of the stack would still represent a major reduction in material relative to standard GEMs.

The work on large mirror coatings at Stony Brook appears to be progressing well.

The fabrication of the new MICROMEGAS prototype with miniature pads also seems to be progressing nicely and the committee looks forward to the results of the characterization tests.

The innovative nano-diamond photocathode work is very interesting. The committee would like to see an estimate of number of photoelectrons (Npe) based on the present understanding of the

QE of the new photocathodes, the transmissions in expected gases for the relevant detector lengths, including all other efficiency factors.

Actions/Recommendations

1. Further report on results with zig-zag electrodes and discussion of physics gains.
2. Results of beam tests of large GEMs
3. Submit proposals for FY19 jointly with RD3

eRD14 PID: Dual RICH radiator

P. Nadel-Turonski reporting

Committee recommendation from July 2017:

There does not seem to be enough support to build a small prototype, as it is not clear to us what would be achieved at this stage of development.

Comments on new efforts:

1. Proponents have done an excellent simulation study of the optical design for a dual RICH detector. The study provided contributions to final Cherenkov angle resolution from various sources of error.
2. It seems that proponents have achieved the goal of the proposed program for the JLab EIC detector concept. They are proposing to continue with this study in FY18 to concentrate on the BNL detector design, which is somewhat smaller.
3. It is important to summarize the study so it can be easily continued after the postdoc leaves in summer.

Actions/Recommendations

1. Summarize the effort.

eRD14 PID: Modular Aerogel RICH (mRICH)

Committee recommendation from July 2017:

As the committee has asked already before during earlier EIC reviews, we expect the proponents to provide a solution to the radiation hardness of the Fresnel lens.

Comments on new efforts:

1. A lens-based Aerogel RICH provides hadron PID capability between 3 and 8 GeV/s for pi/K separation. This performance would be a new record for Aerogel-type of RICH

detectors; this needs to be demonstrated in the test beam. Proponents plan to use 256-pixel MaPMTs to do this.

2. What was achieved: (a) 1-st NIM paper was published, (b) two prototypes and a beam telescope were constructed, and (c) the updated mRICH detector was implemented in the Forward sPHENIX experiment using the Fun4All framework, and (d) started to work on a readout for prototypes.
3. As mentioned before, we would like to see radiation damage tests of the same plastic lens which is to be used in the detector.
4. If you consider SiPMT as a detector option, we would like to see an evaluation of the signal/noise ratio for expected radiation damage of SiPMTs at the EIC. An Aerogel RICH has a small number of photoelectrons/ring and therefore it is sensitive to increased noise.

Recommendations:

1. Continue the efforts as planned. Study radiation damage of plastic lenses.

eRD14 PID: DIRC

Committee recommendation from July 2017:

We expect that the proponents will continue radiation hardness studies of the lens materials. The radiation hardness tests should be extended to a glue choice as well. The radiation damage should be done with a ^{60}Co source as well. We also suggest that the proponents think hard what would happen if there is no working photon detector at 1.5-3T magnetic field. Should one consider an option where bars penetrate the iron as was done for the BaBar DIRC?

Comments on new efforts:

1. This 3-layer cylindrical lens was tested in DIRC beam tests at CERN. Analysis is in progress.
2. We are happy to see a progress in radiation hardness evaluation of NLaK33 lens material. It is not clear what is the relevant maximum dose that is expected in the EIC experiment. This needs to be determined before one can judge results. To test up to a limit of only ~5 krads seems too small. The BaBar DIRC has tested all critical DIRC components up to 100's of krads. A criterion for acceptance was that there must be no effect in transmission at a level of ~20krads; there were some small effects beyond 100-200krads.
3. One should also point out that the radiation damage is wavelength dependent, and it is usually worse at smaller wavelengths. You have tested this effect at 420nm. You should use a monochromator to measure the transmission.
4. A partial recovery of transmission is an interesting effect and should be explored further. The question is how one would use this effect in practice.
5. We would like to see also radiation damage results done with a ^{60}Co source.

6. Development of DIRC and mRICH detectors would benefit from the construction of a large cosmic ray telescope, which would have a thick muon absorber to allow muon momenta larger than 2 GeV, and a 3D-tracking with 1-1.5 mrads resolution. This was done at SLAC for SuperB detector R&D.

Recommendations:

1. Continue the efforts as planned

eRD14 PID: Photosensors (Sensors in large magnetic field)

Committee recommendation from July 2017:

The committee thinks that the experimental work to investigate MCPs at high B-field should be done in parallel with a simulation study. We believe that the work on sensors at large magnetic field should probably be centralized at some point in one location.

Comments on new efforts:

1. We see progress in testing of a Planacon (10-μm pore size) multi-anode MCP-PMT as a function of magnetic field and MCP angle.
2. Panda Photonis MCP-PMT XP-85112 R&D study has shown that the Planacon tube with 10μm holes can operate up to a field of ~2T at a gain of ~$5x10^5$, if one runs at max. high voltage. Please plot the Panda data on top of your data.
3. As mentioned before, the ion feedback is a measure of how good the vacuum is inside the tube. This effect will vary from one tube to the next, and may get worse with the tube's age. One can easily measure it with a single photon source and storage scope. It should be determined if this effect depends on gain or on MCP voltages, by running with magnetic field on and off for the same gain.
4. We used 6 MCP-PMTs in the very the 1-st FDIRC prototype. After realizing that the ion-feedback-driven after-pulse rate increases with voltage, it was decided to run the MCP-PMT at as low a gain as possible (<$5x10^5$), and use a high gain amplifier (140x).

Recommendations:

1. Determine if the ion feedback is dependent on voltage or gain, using magnetic field.

eRD14 PID: Photosensors (LAPPD)

Committee recommendation from July 2017:

The Burle company had MCP-PMT pixilated readout with 1024 pixels worked out ~10 years ago. We suggest that the consortium talk to Paul Hink, now independent consultant, about how Burle made feedthroughs. It should be considered if he could be hired as a consultant? He certainly knows details how the feedthroughs were made. The consortium is encouraged to prepare a setup to evaluate photocathode aging and ion feedback, so this can be easily verified for the photodetectors produced.

Comments on new efforts:

1. ANL group tested a performance of 6cm x 6cm MCP-PMT prototype at the Argonne g-2 magnet facility.
2. The first results in the magnetic field are encouraging. It would be nice to compare them with a simulation, so one can use the simulation to design a better MCP-PMT structure.
3. The plan is to optimize internal MCP voltages, MCP pore size and various dimensions. We hope this is supported by a detailed simulation.
4. The ion-feedback measurement should be measured on all tubes, as a check of outgassing performance.

Recommendations:

1. Continue the efforts as planned

eRD14 PID: Photosensors Electronics

Committee recommendation from July 2017:

Based on the experience with Hawaii electronics for the FDIRC at SuperB and the TOP counter at Belle-II, such electronics will require a substantial and continuous development. Because of that, one should probably limit the number of possible choices.

Comments on new efforts:

1. Different sensors will have different front-end electronics. For example, MCP-PMT will need a much faster amplifier than MaPMT tube or SiPMT. If one will have to run MCP-PMT tubes at as low voltage as possible, one will need to tweak amplifier gain.
2. We agree with a logic to have temporary electronics coupled to a 256-pixel MaPMT to provide a proof of a principle for mRICH using electronics provided by the INFN group led by Marco Contalbrigo.
3. We also welcome the development of new waveform digitizing electronics by G. Varner's group. They have a long-term experience with this type of electronics.
4. All this takes a long-term commitment and feedback from some experimental setup, for example a good cosmic ray telescope.

Recommendations:

1. Continue the efforts as planned

eRD15 R&D for a Compton Electron Detector

J. Hoskins, reporting

The Committee takes note that this effort continues to make good progress on the design of a Compton polarimeter for an EIC, specifically the detector for the Compton-scattered electrons.

The group took some time since the last report to organize their several existing software packages, which had been pressed into service from prior efforts, into a more coherent framework that could allow efficient modelling and thus exploration of parameter space going forward. The group can now study, in a systematic way, various detector geometries, strip width, collimation and apertures, halo source and rate, and vacuum beamline design.

A requested study of strip width was performed and a limit on minimum segmentation, or maximum strip width, was noted. The Committee would like to see going forward a study of this as a function of energy and a demonstration of how robust the conclusion is about segmentation. The Compton asymmetry was extracted, systematic errors determined, and agreement with theoretical expectation of the asymmetry demonstrated, including location of the zero-crossing and the end-point. This is quite encouraging regarding the robustness of the models developed. The group plans to improve the systematics and accuracy determinations.

The group is examining beam halo as well as background due to interaction with beam gas. Levels of somewhat less than 1% of signal were demonstrated, but there are necessarily assumptions made about the sources of background, and these sources need further study. As the EIC machine design develops, it will be important to maintain contact with the accelerator design groups about these issues. The Committee recommends discussing with eRD21, which works on these issues in a comprehensive way, and importing the codes and tools they are developing.

A reference was made to a PEP-II report as a basis for the beam-halo modelling. The Committee

would like to understand if the relevant apertures in that case arose from a polarimeter chicane or from the basic machine aperture. The group noted the importance of controlling the size of the aperture around the Fabry-Perot interferometer in the Compton chicane. Advancing the understanding of this will be an important issue going forward. The tool set developed permits now a systematic study of the chicane dipoles, the interferometer cavity and the detector. The Committee will be quite interested to see these results at the next meeting. These could include a phase-space mapping of background in the detector area.

A write-up of the results and documentation of the software package would be welcome in the next year.

Recommendation:

1. Continue the efforts as planned

eRD16: Forward Silicon Tracking

E. Sichtermann reporting

Following on the discussions and guidance from the Committee in July 2017 the collaboration has continued a simulation effort aimed at understanding layout and configuration of the forward/backward silicon tracker. Studies were shown optimizing disc placement and configuration, pixel size, material, and beam pipe effects. A study was also presented of timing, rates, and pile-up, apparently based, at least in part, on the performance of the ALICE MAPS. Extending this study further, perhaps to shorter integration times, will benefit significantly from discussions with eRD18 and the BNL Instrumentation Division ASIC and sensors groups, to fully flesh out the performance alternatives of MAPS more generally. For example, MAPS considered for HL-LHC would be much faster. In the end, of course, there needs to be an optimization between power, pile-up, granularity, material etc. and this will only occur with everyone participating.

Actions/Recommendations

1. It remains interesting to understand the optimization regarding front end electronics. The ALICE MAPS is not optimized for this environment. What about the faster architectures under development for HL-LHC. Effort would benefit from dialog between RD16, RD18, and BNL Instrumentation Division.

eRD18: Precision Central Silicon Tracking & Vertexing for the EIC

P. Jones reporting

This effort focuses on central tracking within two work packages, WP1 being sensors and electronics and WP2 being simulation. For WP2, staffing issues interrupted this effort partially but it is reviving. Some resources will be shifted to an ASIC design study for fast timing.

For WP1 excellent progress was shown in the bench test and evaluation of sensors and pixel variants from the standard and new modified Tower-Jazz process. Comparative studies of risetime and charge collection were shown. Upcoming studies will also look at other variants and architectures. The collaboration is encouraged also to make contact with interested colleagues in the BNL Instrumentation Division.

With regard to the proposed study of a faster, lower granularity, outer "timing" layer, the Committee looks forward to hearing results for that study at the next meeting.

eRD18 is strongly encouraged to engage more with eRD16 to inform studies and simulations on both sides.

Actions/Recommendations

1. Continue to engage with RD16 going forward
2. Present results of study of outer timing layers.
3. Further inform technology with discussions with BNL Instrumentation Division

Expression of Interest from BNL Instrumentation Division

S. Li reporting

This presentation focused on technical aspects of MAPS design, architecture, and performance. Characteristics of existing and planned MAPS variants were described and the capabilities of the BNL Instrumentation Division were discussed as relates to this area. A particular SOI approach was offered as a possible direction.

The Committee was pleased to see the presentation and encourages the Division to begin substantive discussions with members of eRD16 and eRD18, and with the broader EIC tracking and physics community to better understand the requirements and trade-offs appropriate for an application to tracking at an EIC.

The table presented, comparing technologies, is a good start at the kind of general analysis the Committee has asked for, but this needs to be further expanded with the particular needs of the EIC operating environment and performance requirements factored in.

Actions/Recommendations

1. Begin discussions with members of eRD16 and eRD18, towards a more unified approach to semiconductor tracking and EIC; please report at the next meeting

General Comment to all the silicon tracking proponents

As the Committee understands the R&D so far, the silicon trackers are seen as being within, and dependent upon a different outer tracking system (i.e. TPC). The Committee notes that the large

LHC detectors have moved to all silicon trackers. The emerging MAPS technologies are now seen as an attractive possibility for future all-silicon tracking systems which combine high granularity with low mass at a potentially attractive price point. The Committee wonders whether a future EIC silicon tracking consortium may consider such an option as well, which may be better timed than for the HL-LHC?

eRD17 BeAGLE: A Tool to refine Detector Requirements for eA Collisions

M. Baker et al.

The Committee takes note that the development of BeAGLE continues apace and has made good progress since the last meeting. The effort appears to be on track for a first release of the code by FY2019.

The Committee takes note of the three main areas of development, which cover technical improvements to the code and needed corrections to kinematics employed, handling of the Fermi momentum of the struck nucleon, and improvements to handling the A-dependence of diffraction. A major upcoming effort is to install RAPGAP into BeAGLE as an alternative to Pythia, an effort that is just getting underway and that can be expected to have reached at least the alpha-test stage by the latter part of 2018.

A physics insight regarding incoherent vs. coherent diffractive scattering has already resulted from this work, clarifying some of the 'lore' concerning this and how it affects tagging of such events using Zero Degree Calorimeters at an EIC. The planned ZDC are found to be insufficient to veto-tag incoherent e-A events without additional detectors, as noted in the groups' last report. The incoherent events are a major background for coherent diffraction. Coherent diffraction has a cross section proportional to gluon density squared and is one key to the study of parton saturation. However, the group has now demonstrated that even for example J/psi diffractive events, which have a small re-scattering probability, still interact strongly enough with the nucleus to allow significant geometry tagging. One thus has a means to tag impact parameter. A set of plots relating impact parameter to mean excitation energy and then related excitation energy to mean number of evaporated neutrons were given, as well as a partner set relating impact parameter to mean number of evaporated neutrons and the complementary dependence of the mean impact parameter for a given number of evaporated neutrons. It would be of interest in the next report to see the spectra of excitation energy and of the number of evaporated neutrons to gain an appreciation of the spread of these quantities.

A task list for the full effort was presented in the last report and is clearly being worked through. There have been some minor diversions to address and correct technical issues, but overall progress is quite encouraging. The Fermi motion code is ready to test, the kinematic matching

(consistency, actually) between DPMJet and Pythia noted in the last report is now resolved, the detailed handling of cross sections as a function of x and Q^2, as opposed to using average values, is being implemented, and the input information for more values of nuclear mass A is being added. It is expected the central effort going forward will be implementing the RAPGAP code, then following with a beta release of the code to first users.

This effort appears headed to a successful conclusion. The group is commended for its focus, attention to detail, and pursuit of a (feasible!) release date.

Actions/Recommendations

1. None

eRD20 – Developing Simulation and Analysis Tools for the EIC

A. Kiselev reporting

The collaboration has made significant progress on a wide variety of tasks in the past few months. The "Container" concept seems to be an especially significant step forward towards providing easy to use tools for simulating an EIC class detectors. The group is to be congratulated for achieving so much so quickly.

Actions/Recommendations

1. None

eRD21 PID: EIC Background Studies and Impact on the IR and Detector design

L. Elouadrhiri

Committee recommendation from July 2017:

The work described in this proposal will be valuable for both the eRHIC or JLeIC designs and is an important study worthy of support. As noted by the authors, neutrons with energies around a few hundred keV can be detrimental to detector components. A quantitative estimate of the neutron flux is needed for detector development and placement. To achieve this, modeling the full neutron thermalization from beam-gas events in the experimental hall should be included in the study.

The committee notes that eRD19 is a funded project on the same topic but is currently stalled due to a postdoc leaving. We encourage the proponents of eRD19 to collaborate with the proponents of this work.

Comments on new efforts:

1. Significant progress has been made since the start of the program. They have completed: (a) the HERA benchmarking of the background rates, (b) modeling the current baseline design of the JLEIC IR beam pipe concept in the GEMC/GEANT4 simulations, (c) readied the Synchrotron Radiation (SR) program developed at SLAC by collaborator Mike Sullivan, and (d) a concept of the IR beam pipe has been developed. The committee was impressed with the presentation.
2. The plan is to evaluate the background radiation reaching the detectors and front-end electronics.
3. It is important not to miss some source of background. Since the EIC detector will likely use a large number of SiPMs, it is important to get the neutron rate right, including thermal neutrons, which are more difficult to simulate. We are happy to see that the proponents will study this issue in the future.
4. It is useful to quote one example: the initial neutron background predictions for the DIRC detector at BaBar were completely wrong. As a result, emergency measures had to be taken to find the source inside the BaBar detector with the help of a Geiger counter, erect a temporary shielding, run like that for a year, before a final shielding was installed.

Actions/Recommendations

1. Continue the efforts as planned

eRD22 PID: GEM based Transition radiation detector and tracker

Y.Furletova reporting

Committee recommendation from July 2017:

It is recommended that the project be funded at a level below the requested amount, and that its first phase focuses on MC optimization of the counter parameters, such as radiator thickness, Xe drift length thickness among others.

Comments on proposal:

1. We are happy to see progress in the area of GEANT4 studies of various TRD designs. More work in this area is needed, especially, to tune variables relevant for the future TRD detector at an EIC.
2. There was also progress on the experimental side. The committee did not request it, but outside LDRD funds were found. Proponents have chosen a standard CERN 10 cm x 10 cm triple-GEM kit, and added to it a standard JLAB FADC readout. We were told this is

the first time a GEM detector will be used for a TRD. We will be happy to see test results in next meeting.

Actions/Recommendations

1. None